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November 28, 1997

Re: Indian Point Unit No. 2
Docket No. 50-247
LER 97-018-01

Document Control Desk
US Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555-0001

The attached Licensee Event Report LER 97-018-01 is hereby submitted in accordance with the requirements of 10 CFR 50.73

Very truly yours,

Paul H Kinkel

Attachment

cc: Mr. Hubert J. Miller
Regional Administrator-Region I
US Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. Jefferey F. Harold, Project Manager
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US Nuclear Regulatory Commission
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IE22

CATEGORY 1

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AUTH.NAME AUTHOR AFFILIATION
KJELLBERG,I.G. Consolidated Edison Co. of New York, Inc.
KINKEL,P.H. Consolidated Edison Co. of New York, Inc.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-018-01:on 970726,load shed of main generators external loads caused main turbine to trip on mechanical overspeed which in turn generated RT.Caused by loss of power to four 6.9kv buses.Fuses have been eliminated.W/971128 ltr.

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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-104

EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Indian Point Unit No. 2	0 5 0 0 0 2 4 7	1 OF 0 5

TITLE (4)

BUCHANAN'S SUBSTATION RINGBUS BREAKER TRIP CAUSES IP2 TURBINE OVERSPEED TRIP AND REACTOR TRIP.

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 7	2 6	9 7	9 7	- 0 1 8 -	0 1	1 1	2 8	9 7	None	0 5 0 0 0
										0 5 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check one or more of the following)* (11)

OPERATING MODE (9): N	20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10): 0 9 9	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER *(Specify in Abstract below and in Text, NRC Form 366A)*
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
Ingvar G. Kjellberg, Senior Engineer	9 1 4	7 3 4 - 5 5 6 7

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES *(If yes, complete EXPECTED SUBMISSION DATE)*	X NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines)* (16)

On July 26, 1997, with the unit at 99.4 percent power, misoperation of a protective directional relay in transformer TA-5 at the Buchanan substation resulted in tripping the power transmission system load from the IP2 main generator. The load shed of the main generator's external loads caused the main turbine to trip on mechanical overspeed which in turn generated a reactor trip. The main generator electrical output to the unit auxiliary transformer increased in frequency due to the overspeed condition of the main turbine, which caused an increase in the rpm of all electrical pump motors connected to the unit auxiliary transformer at the time of the event. Approximately seven (7) seconds later an overcurrent condition on the unit auxiliary transformer tripped the electrical generator. The frequency mismatch at the time of transfer between the 6.9 kV buses powered by the unit auxiliary transformer and those powered by 138 kV supply to the station auxiliary transformer prevented automatic transfer of loads to the station auxiliary transformer. This caused loss of power to four (4) 6.9kv buses and their associated loads. Loss of power to the reactor coolant pumps (RCP's) brought the plant into a natural circulation cool down condition. The natural circulation condition lasted 40 minutes, after which a RCP was started and forced circulation was restored. Plant systems operated as designed.

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse 4-Loop Pressurized Water Reactor

IDENTIFICATION OF OCCURRENCE:

Turbine overspeed trip due to loss of external load followed by a reactor trip.

EVENT DATE:

July 26, 1997

REPORT DUE DATE:

August 25, 1997

REFERENCES:

CITRS No 97-E02832

PAST SIMILAR OCCURRENCE:

None

DESCRIPTION OF OCCURRENCE:

On July 26, 1997 at 09:06:17 AM a turbine overspeed trip occurred caused by loss of the output load of the main IP2 generator. The turbine trip caused an immediate reactor trip. At the time of the event Buchanan's north ringbus was connected to feeder (Y94) from Ramapo substation, to feeder (W95) from IP2 and to transformer TA-5 (which supplied power to the 138 kV system). The Sprain Brook load feeder (W93) was out of service for a wave trap replacement. The reactor was operating at 99.4 percent power and the electrical output was 966 MWE.

The load current through transformer TA-5 is monitored by a directional relay. The purpose of this relay is to determine if the current through the transformer is going out to the 138 kV loads or if the current flow is reversed feeding the ringbus. The directional relay is designed to trip breakers 7, 11 and F7 at a given current setpoint when the current through transformer TA-5 is feeding the ringbus and to inhibit the actuation of the directional relay when the current goes out to the 138kV load. During this event when TA-5's current setpoint was reached the actuation inhibit circuit did not work and the directional relay actuated. This misoperation sent an open signal to breakers 7,11 and F7. Opening of breaker F7 isolated transformer TA-5 from the 138kV system. When Breakers 7 and 11 opened, the system load of the IP2 main generator was disconnected. With the Sprain Brook feeder

TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF OCCURRENCE (continued):

disconnected from the ringbus for maintenance, there was no power transmission path available.

The loss of electrical load caused the main turbine to overspeed and then trip on mechanical overspeed as designed. The turbine trip in turn tripped the reactor. The main generator remained operational for about seven seconds after the turbine trip until an overcurrent condition on the unit auxiliary transformer tripped it out. During this time (approximately 7 seconds) the electrical output to the unit auxiliary transformer increased in frequency above its normal 60 hertz due to the overspeed condition on the main turbine. The frequency escalated to between 68 and 73 hertz, causing all operating AC rotating equipment powered by internal 6.9 kV buses 1-4 to overspeed. A frequency mismatch then occurred between the 6.9 kV buses 1-4 powered by the unit auxiliary transformer and the 138 kV supply to the station auxiliary transformer, which powers 6.9 kV buses 5 and 6. Due to this frequency mismatch the 6.9 kV load from the Unit Auxiliary transformer did not transfer to the station auxiliary transformer when the generator tripped. The non-transfer of internal loads to the station auxiliary transformer resulted in a power loss to the reactor coolant pumps and 480 VAC buses 3A and 2A. This placed the plant in a natural circulation cool down condition. The motor driven auxiliary feed water (AFW) pump 21, which is powered from the 480 VAC bus 3A, did not automatically start due to the loss of bus 3A. The emergency diesel generator 22 started and was available to be manually connected to buses 2A and 3A as per design. The AFW pumps get an automatic start signal on low steam generator level. Low steam generator level is a normal characteristic of a full power reactor trip. The steam driven AFW pump 22 and the motor driven AFW pump 23 did automatically start as designed. Operators used AFW pump 22 to feed steam generators 21 and 22 that are normally fed from AFW pump 21.

The plant was in a natural circulation condition for 40 minutes. Throughout the natural circulation phase of this incident, fixed core exit thermocouple indications, the saturation meters and other related instrumentation were monitored providing verification that adequate core cooling existed at all times. The 6.9 kV buses 1-4 were manually transferred to the station auxiliary transformer power supply by the operators four (4) minutes after the generator trip. The 480 VAC buses 2A and 3A were then energized via their normal supply breakers from the 6.9 kV buses. AFW pump 21 was started and then used to feed 21 and 22 stream generators. AFW pump 22 was secured. Forty (40) minutes after the plant trip the pre-startup check of 24 RCP was completed and the pump was restarted. This restored forced circulation for the reactor coolant system.

The investigation of the event has shown that transformer TA-5's directional relay misoperated because fuses associated with its directional element were blown. There were heavy rains in the area prior to the event. It has been determined that rainwater seeped into the fuse box and is most likely the reason why the fuses blew.

TEXT (If more space is required, use additional NRC Form 366A's) (17)

ANALYSIS OF OCCURRENCE:

This report is being made because an automatic actuation of the Reactor Protection System (RPS) and the Engineered Safety Features System (ESF) occurred, which are reportable under 10 CFR 50.73(a)(2)(iv). This report has been revised to include information unavailable at the time of the initial issuance. The information included in this supplemental report relates the potential long term effects, if any, on the reactor coolant system from the overspeed event and to the determination of root cause and appropriate corrective actions.

During the event, as described above, a misoperation of a transformer TA-5 directional relay tripped ring bus breakers 7, 11 & F7 and caused a load shed of 930 MWe from the main unit generator, isolating it from the system grid without causing a generator trip. The subsequent increase in turbine speed tripped the turbine and the reactor on turbine overspeed. The increased generator rpm increased the motor speed on all pumps connected to the unit transformer via 6.9 Kv buses 1 through 4 and also via the 480 V buses 2A and 3A. It should be noted that a loss of load should have generated an immediate 6.9 Kv bus transfer of the unit auxiliary transformer loads over to the station auxiliary transformer. This transfer, which is initiated by the simultaneous opening of ringbus breakers No. 7 & No. 9, is designed to maintain the 6.9 Kv power feed to several 6.9 kv pumps including the four (4) RCP's in a loss of load situation. However, the Sprain Brook Feeder was taken out of service approximately 6 hours before the event occurred. Breaker 9 was closed to maintain ringbus integrity, which gives the network protection from a single breaker malfunction. This action defeated the direct generator trip and the bus transfer. If breaker 9 had been left open, tripping breaker 7 would have generated a direct IP2 generator trip and the 6.9 Kv load transfer which in turn would have prevented the subsequent pump overspeed condition.

The consequences of the overspeed conditions experienced during this event are analyzed below. Per UFSAR Section 4.2.2.5.4 the RCP's run at 1189 rpm. Their maximum speed is 1486 rpm (125 percent of operating speed). Westinghouse has performed an evaluation to provide assurance that no long term effects were associated with this event. In accordance with Westinghouse's report, the RCS components that could have been potentially affected by the excess RCS flow are the Reactor Fuel, the Reactor Vessel Internals and the Reactor Coolant Pumps. Westinghouse found that "gross tilting" or rocking of the internals to be limiting with respect to allowable flow conditions. The new limit of 115.8% RCS flow is more limiting than the previously identified RCP speed. The UFSAR Section 4.2.2.5.4 125 % RCP speed value is non conservative since it corresponds to a RCS flow value of 125%. The recorded reactor coolant flow change during the event was 15.7%.The total flow increased from 96.0 % to 111.8 %. This excess flow condition lasted for approximately 10 seconds. The flow increase did not adversely impact the reactor internals.

Auxiliary feed water pump 21 did not auto-start due to loss of bus 3 A. This condition was a consequence of the failure to automatically transfer the 6.9 kV buses 1 through 4 over to buses 5 and 6 The emergency diesel generator 22 started and was available to be manually connected to buses 2A and 3A as per design. During the Event The 6.9 kV buses were manually transferred to the station auxiliary transformer power supply by the operators (four (4) minutes after the generator tripped) per procedure and the 480 VAC buses 2A and 3A were then energized via their normal supply breakers from the 6.9 kV buses. AFW pump 21 was started and then used to feed 21 and 22 steam generators. AFW pump 22 was secured.

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TEXT *(If more space is required, use additional NRC Form 366A's)* (17)

CAUSE OF OCCURRENCE:

The misoperation of a directional relay on transformer TA-5 tripped ring bus breakers 7, 11 and F7. The relay tripped because fuses associated with it's directional element were blown. The function of the directional element was to inhibit actuation of the directional relay if the current flow was directed to supply the 138 kV load. This inhibit feature did not work and when the load current through transformer TA-5 had increased to the pick-up current value the relay actuated. A contributing factor to the increase in the TA-5 load current was that the Sprain Brook load feeder was taken out of service.

The feeder/ breaker configuration associated with Buchanan substation's north ringbus design, at the time of the trip, played an important role in this event. If the Sprain Brook load feeder would have been in service IP2 would not have been affected by the event. The normal ring bus configuration would have kept IP2 connected to the system via breaker 9, its Sprain Brook connection. However, with this feed taken out of service, misoperation of a TA-5 directional relay caused a loss of IP2 main generator's system load without tripping the generator. This condition resulted in an increase of motor speed on several essential pumps in combination with putting the unit in natural circulation cool-down condition. The existing design generates a direct generator trip only when both breaker 9 and breaker 7 are opened simultaneously (because this configuration isolates the IP2 generator from the system grid). The relay tripped out breakers 7,11 and F7. Breaker 9 remained closed at this time which prevented a direct generator trip. With the Sprain Brook load feeder out of service IP2 is more vulnerable to an overfrequency condition. For this specific configuration operating with breaker 9 open would have prevented an over frequency condition by tripping the generator when breaker 7 opened.

CORRECTIVE ACTIONS:

- The fuses to the directional relay have been eliminated from the design and the fuse holder box housing the spliced wires has been waterproofed.
- Administrative controls have been put in place to control the operation of ringbus breakers 7 and 9 at the Buchanan Substation such that if the feeder breaker load is removed from service the breaker will be left in its open position to arm the direct trip from the other breaker.
- A review of the unit protection design has commenced to determine if modifications, such as RCP's or generator overfrequency trips, supplementing administrative controls, will enhance the existing design. This design review is scheduled to be completed by 2/28/98
- Appropriate design and licensing basis documentation will be revised to include the more limiting RCS flow conditions.